OFFICE OF NAVAL RESEARCH

Grant or Contract N00014-89-J-1590

R&T Code 413m012

Technical Report No. 10

Characterization of PMDI/HOPG Interfaces by SERS Using a Silver Overlayer Configuration

by

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Presented

at

13th Annual Meeting of The Adhesion Society
Savannah, GA
February 18-21, 1990

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Cincinnati, OH 45221-0012

June 1, 1990

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION None	1b. RESTRICTIVE MARKINGS None
2a. SECURITY CLASSIFICATION AUTHORITY None	3. DISTRIBUTION / AVAILABILITY OF REPORT This document has been approved for public release and sale; its distribution is unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE None	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Report #10	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION University of Cincinnati 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Office of Naval Research
6c. ADDRESS (City, State, and ZIP Code) Department of Materials Science Cincinnati, OH 45221-0012	7b. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, VA 22217
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Office of Naval Research 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-89-J-1590
8c. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, VA 22217	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO.: N00014-89 / PROJECT NO.: J-1590 / TASK NO.: 413m012 / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
Characterization of PMDI/HOPG Interfaces by SERS Using a Silver Overlayer Configuration

12. PERSONAL AUTHOR(S)
W. H. Tsai and F. J. Boerio

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Technical Report	FROM _____ TO _____	June 1, 1990	2

16. SUPPLEMENTARY NOTATION
Presented at 13th Annual Meeting of The Adhesion Society, Savannah, GA, Feb. 18-21, 1990.

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Surface-enhanced Raman scattering (SERS) was used for characterization of model fiber/polyimide interfaces. Pyromellitic diimide (PMDI) was used as a model polyimide while highly oriented pyrolytic graphite (HOPG) was viewed as a model graphite fiber. Samples for SERS were prepared by depositing films of PMDI onto HOPG and then depositing silver island films on top of the PMDI. When the PMDI films were relatively thick (85 A), the SERS spectra were similar to normal Raman spectra of bulk PMDI. These spectra were characterized by the imide bands near 1775, 1748, 1368, and 659 cm^{-1} and by the benzene ring bands near 1633, 1200, 762, 578, and 520 cm^{-1}, respectively. For thin films of PMDI (about 15 A), the SERS spectra were considerably different from normal Raman spectra of PMDI and SERS spectra of thick PMDI films on HOPG. The 1775 cm^{-1} band due to a C=O stretching vibration and the 762 cm^{-1} band related to a ring breathing mode were weak while the 1368 cm^{-1}

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Joann Milliken	22b. TELEPHONE (Include Area Code) (202)696-4410
	22c. OFFICE SYMBOL

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

19. Abstract (continued)

band due to a CNC axial stretching vibration and the 1200 cm^{-1} band due to a CNC axial stretching vibration and the 1200 cm^{-1} band due to a CX in-plane stretching mode were strong. Differences in the relative intensities of bands in the SERS spectra were attributed to orientation effects. It was concluded that PMDI films deposited on HOPG were actually bilayers in which the molecules adjacent to the surface were adsorbed with a vertical conformation in which the planes of the molecules were perpendicular to the surface and one imide group was in contact with the surface. Molecules farther away from the surface had a random orientation.